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THE SOUTHERN GREEN PLANT-BUG.

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INTRODUCTION.

In the extreme southern portion of the United States, particularly in those States bordering the Gulf of Mexico, a large pentatomid bug, *Nezara viridula* L., is a serious pest on cultivated plants. Important vegetable and truck crops are subject to injury and it is as an enemy of such crops that the species is considered in this article. The investigations upon which the article is based have been carried on principally at Baton Rouge, La.[1]

Nezara viridula is here given the name of "the Southern green plant-bug." The word "Southern" is proposed to distinguish the species from the closely related *Nezara hilaris* Say. While the latter is also a pest on cultivated plants, and approaches *viridula* in color, its range extends farther north in the United States than does that of *viridula*.

NATURE OF DAMAGE.

Both adults and nymphs feed by inserting their beaks into the plant tissue and extracting the plant juices, minute spots marking the points where the beak has punctured. The growing shoots of plants, and especially developing fruit, are preferred as feeding

[1] The writer wishes to acknowledge the cooperation, in this investigation, of Messrs. C. E. Smith and J. L. E. Lauderdale, while members of the Bureau of Entomology. The drawings of figures 4, 5, 9, 12, and 13 and the photographs (figs. 1–3 and 6–8) have been prepared by Mr. W. M. Dovener of the Bureau of Entomology.

places. Attacked shoots usually wither and are either retarded in their growth or, in cases of severe infestation, die. Such damage has been noted on Irish potato and sweet potato.

In the case of immature fruit the tissue around the point where the beak has been inserted does not develop normally and these points sometimes become centers of callous growth. The growth of developing fruit is retarded when injured in this manner and the fruit often withers and drops from the plant. Injured tomatoes, although small and distorted, sometimes assume a yellow color.

During 1917 injury by the nymphs to tomatoes and beans was demonstrated by confining nymphs with tomato fruits and growing beans. In the case of tomato a number of small green fruits

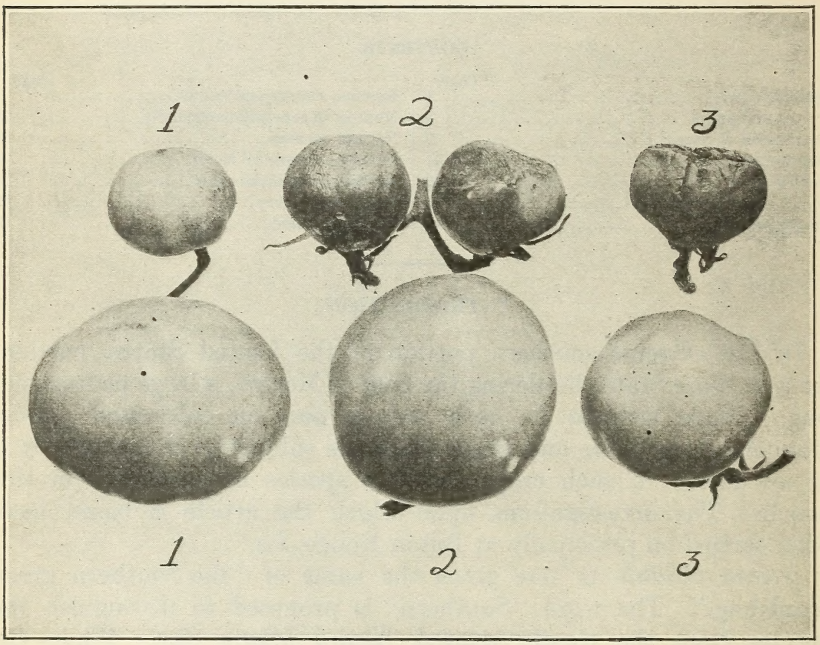

FIG. 1.—Injury to tomato fruit by nymphs of the Southern green plant-bug (*Nezara viridula*): Injured fruit above, normal fruit below. Developing fruit was covered with cheesecloth sacks in which nymphs were confined. Fruit bearing same number was approximately same size when inclosed in sacks.

growing in the field were closely covered with cheesecloth. In some of these covers nymphs were placed while other fruit was left to serve as checks. Examination later showed that those fruits with which nymphs had been confined had not developed to the same extent as did the check fruit. In some cases the fruits upon which nymphs had fed withered later and dropped from the stem. (See fig. 1.)

Beans growing in flowerpots were placed under covers. Nymphs were confined with some, while other plants were used as checks. No fruit developed on those plants upon which nymphs were allowed

to feed. While the amount of fruit that developed on the check plants was not as great as it would have been under natural field conditions, the effect of the feeding of the nymphs was apparent when plants receiving the two treatments were compared. (See fig. 2.)

During 1916 an unusual type of injury to cauliflower was reported from Breaux Bridge in St. Martin Parish and from Terrebonne Parish, La. This was apparently due to the feeding of both adults and nymphs of the Southern green plant-bug. They were numerous

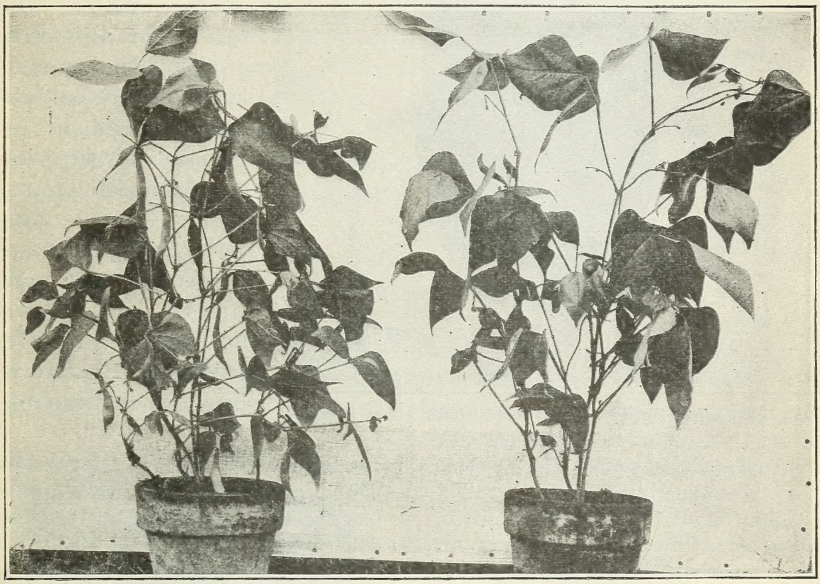

FIG. 2.—Injury to beans by nymphs of Southern green plant-bug. Beans growing in flowerpots were placed under wire cages. No pods developed on plants at right, with which nymphs were confined.

at and about the point where the leaf stems are attached to the main stalk of the plant. The stems became discolored and the leaves dropped prematurely.

DESCRIPTION OF STAGES.

THE ADULT.

The adult (fig. 3) when viewed from above has the characteristic form of the family Pentatomidæ, which may be described as shield-shaped. The dorsal surface of the body is slightly, and the ventral surface strongly, convex.

In living specimens the body as well as parts of the appendages are usually light green, the dorsal surface being somewhat darker than is the ventral surface. Exceptions to this may be found in the case of adults collected during the cooler months of the year. Such individuals are darker in color, perhaps because of the lower temperatures

to which they are subjected, the light green in certain individuals being replaced by purple. Mounted specimens are usually dull green.

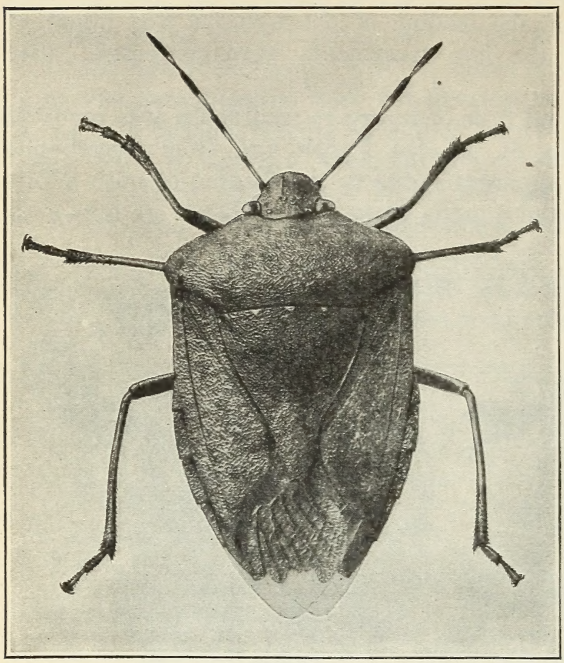

FIG. 3.—Southern green plant-bug (*Nezara viridula*): Adult. Enlarged about 4 diameters.

There is considerable variation in size, the average female being somewhat larger than is the average male. The sexes are differentiated by the appearance of the last abdominal segment, especially by the presence of a notch in the margin at the posterior end of the abdomen of the male (fig. 4.). This notch is not present on the female (fig. 5). A technical description follows.

Subovate, dorsal surface slightly convex, ventral surface strongly so. Color usually green, sometimes tinged with purple. Head somewhat prolonged, angular, tylus equalling cheeks. Eyes very dark red or black, ocelli appearing as tiny beads of amber. Antenna five-jointed; in comparative length the order is as follows: First, second, fifth, third, and fourth, the fourth being the longest. In green specimens the distal end of third antennal segment, and at least the distal half of fourth and fifth, is dark, of a red or brown color. Labrum dark red or brown, a dark line extending from the end of the labrum to dark tip of beak. Sides of pronotum nearly rectilinear. Three or five white points at base of scutellum along edge of pronotum. Black dot at each basal angle of scutellum. Distal end of tibia, and the tarsi, brownish. Small black dots along sides of abdomen at posterior tip of each segment. In purplish specimens coloration not so apparent. When wings are folded, entire surface of body, except membranous portion of wings, roughened by numerous punctures, especially dense on dorsal surface. Osteolar canal or orifice short, rather broad, truncated at apex, and not extending more than half way to lateral margin of metapleura.

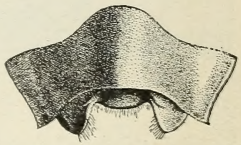

FIG. 4.—Southern green plant-bug: Ventral view of tip of abdomen of male. Greatly enlarged.

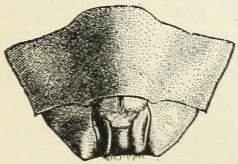

FIG 5.—Southern green plant-bug: Ventral view of tip of abdomen of female. Greatly enlarged.

From center of base of head to tip of abdomen 10 males average 12.1 mm., ranging from 11 to 13.5 mm. Average width at shoulders 7.85 mm., ranging from 7 to 8.5 mm. Average length of 10 females 13.15 mm., ranging from 12 to 15.5 mm. Average width at shoulders 8.3 mm., ranging from 7.5 to 9.5 mm. Average length of head about 2 mm.

COMPARISON WITH OTHER SPECIES OF NEZARA.

Four species, namely, *viridula* L., *pennsylvanica* DeG., *hilaris* Say, and *marginata* P. B., usually have been considered as belonging to the genus Nezara.[1] Whether considered of sufficient importance to be a generic character, or only a specific one, the difference in the shape of the orifice (osteolar canal) is the most satisfactory character for separating *viridula* from the other species. In *viridula* (fig. 6) the orifice is short, rather broad, truncated at the apex, and does not extend more than half way to the lateral margin of the metapleura. In the other three species (see fig. 7) it is long and curved, becoming gradually evanescent, and extends almost to the posterior lateral angle of the mesopleura.[2]

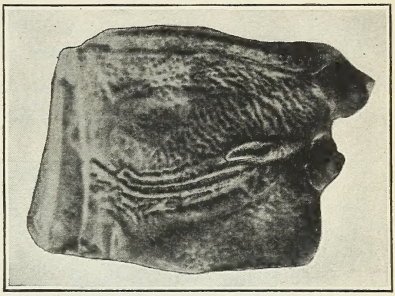

FIG. 6.—*Nezara viridula:* Portion of ventral surface of mesothorax and metathorax, showing the orifice or osteolar canal. Coxæ of legs of second and third pairs at right. Greatly enlarged.

THE EGG.

The egg (figs. 8 and 9) is cylindrical, rounded at the lower end and flattened on top. On the top are the short, club-shaped chorial processes arranged in a circle and attached to the egg between the cap and the outer edge by their smaller ends. Their distal ends are bent toward the center of the cap. The writer has found the number of chorial processes on an egg to range from 28 to 32. Whitmarsh (13),[3] in his description of the stages of *Nezara hilaris*, states that there are as many as 65 of these processes on the egg of that species.

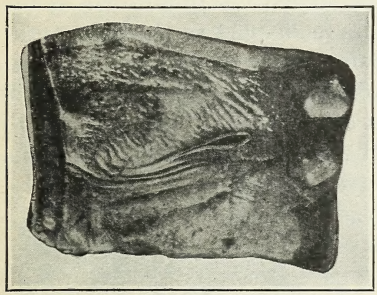

FIG. 7.—*Nezara hilaris:* Portion of ventral surface of mesothorax and metathorax, showing the orifice or osteolar canal. Coxæ of legs of second and third pairs at right. Greatly enlarged.

The surface of the egg is roughened, with traces of hexagonal markings. A number of eggs that the writer has measured gave an average height of 1.24 mm. and an average diameter of 0.85 mm.

[1] Some writers include *viridula* only under this genus, placing the other three species under the genus Acrosternum of Fieber.

[2] Some authorities mention other characters by which *viridula* may be distinguished, but the writer, finding some of these inconstant, considers it advisable to mention only the difference in the shape of the orifice.

[3] Numbers in parentheses refer to "Literature cited," p. 26.

When first deposited, eggs that have been kept under observation were of a cream color. Later they became salmon color and just before hatching the crimson markings of the inclosed nymphs were visible through the shell, a somewhat triangular area on the head being especially conspicuous.

NYMPH STAGES.

There is a marked variation in the coloration of different nymphs in the same period of growth and individuals vary considerably in coloration from day to day. The writer has observed a marked difference in coloration of different individuals after the third and fourth molts, as indicated by Morrill (7) in his figures of nymphs in the fifth instar. There are found in the fourth and fifth instars both light and dark nymphs, as well as others of intermediate coloration. In the case of numerous individuals that have been under observation it has been found that in the fourth instar the percentage of nymphs of the light and dark types—if such they may be called—is about the same. Nymphs in the fifth instar belong for the most part to the light type.

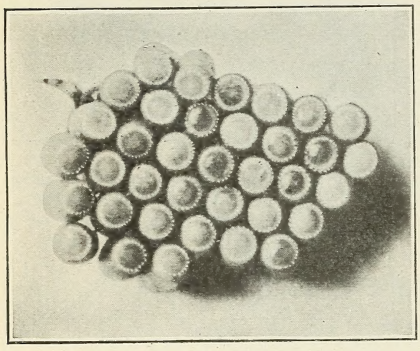

FIG. 8.—Southern green plant-bug: Egg-cluster, viewed from above. Enlarged about 6 diameters.

In the following descriptions the color notes should not be considered as having too great significance. Up to and including the third instar these notes refer, in so far as coloration is concerned, to normal or average nymphs, during the summer months. For the nymphs in the fourth and fifth instars two forms are described. One represents the darkest and the other the lightest form that the writer has found.

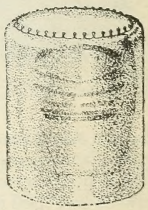

FIG. 9.—Egg of Southern green plant-bug, lateral view, showing embryo within. Highly magnified.

While the writer has not had the opportunity of examining the nymph stages of *Nezara hilaris*, the species with which *viridula* is most likely to be confused in the United States, it is evident from Whitmarsh's (13) descriptions and figures, especially with regard to the coloration and markings on the dorsal surface of the adbomen, that the nymphs of *hilaris* and *viridula* are quite distinct. In *viridula* the number and arrangement of the light-colored spots on the dorsal surface of the abdomen of nymphs in the second to fifth instars, inclusive, are very constant (although some of them are not apparent in the fifth instar, as they are covered by the wing pads), and serve to distinguish the nymphs from those of *hilaris*, in which these spots are not present. (Figs. 10 and 11.)

Dorsally the surface of the head and thorax of all stages is roughened by punctures and wrinkles. The surface of the abdomen is smoother, the punctures and wrinkles present being largely confined to areas around the glands and along the sides. Short setæ are scattered over the surface of the body and appendages. The margins

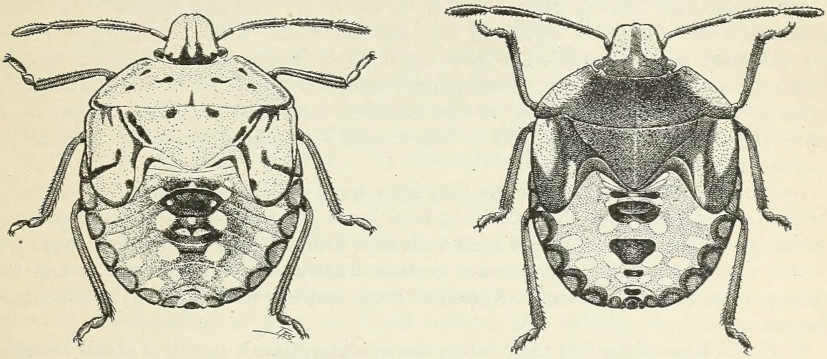

FIG. 10.—Southern green plant-bug (*Nezara viridula*): Nymph, fifth instar; light and dark types Enlarged about 4 diameters. (Morrill.)

of the thorax, which in the instars succeeding the first are serrated, are most prominent in the third and fourth instars.

Immediately after molting the abdomen of the nymph is quite flat dorso-ventrally but it gradually becomes thicker, until just before the new molt it is turgid and glistening. The nymph increases

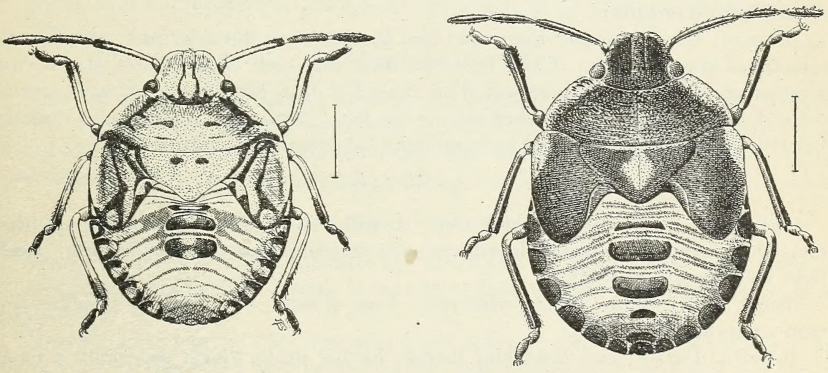

FIG. 11.—The green plant-bug (*Nezara hilaris*): Nymph, fifth instar; light and dark types. Enlarged about 4 diameters. (Morrill.)

in size from the beginning to the end of any instar and the length and width is also increased through molting.

Especially in the last two instars there is considerable variation in the size of different individuals in either stage even just after or before molting. This, of course, would be expected from the variation in size of the adults.

In molting the skin splits down the median line of the thorax and at the juncture of the head and thorax on the dorsal surface. Through this opening the nymph gradually works its way, leaving the entire covering of the body behind.

FIRST-STAGE NYMPH.

Ovate, strongly convex above, less so below. Body and appendages with short, scattered setæ. Antennæ, beak, and legs long and stout. Antenna four-jointed; first joint shortest, second and third of about equal length, fourth longest, largest at middle and approaching point at tip.[1] Four-jointed beak reaching beyond base of abdomen. Eyes prominent. Claws simple, two in number, each with pulvillus. Divisions of body and segments of thorax, and to less extent segments of abdomen, marked by indentations along edge.

As the nymphs issue from the eggs they are colored as follows: Eyes and a triangular area on top of head, one edge extending from lower point of one eye to lower point of other eye, crimson; remainder of head yellowish white. Thorax and abdomen golden yellow except for traces of transverse crimson lines which, between thorax and abdomen, form a transverse band. Antennæ, beak, and legs without color, nearly transparent.

Until the time of the first molt, when the nymphs attain a length of about 1.6 mm. and a width of 1.1 mm., they become gradually darker.

The following notes refer to their coloration just before molting:

Dorsal surface.

Head: Eyes deep red. Triangular area on head crimson or brown. At least area at base light yellow. Rest of head sometimes brown or in part yellow.

Thorax: Central portion of prothorax and mesothorax light yellow, the sides and rear of this area sometimes tinged with red. Sides of prothorax and mesothorax reddish brown or brown, with yellow sometimes present along edge. Metathorax reddish brown or brown.

Abdomen: Usually darker than head and thorax. For the most part dark brown, sometimes almost black. White spot on either side near base. Three glands, the anterior one being much narrower than the other two, reddish brown with cream-colored spot behind and to either side of last two. Somewhat semicircular, usually yellowish spot on either side of each segment, its straight edge along edge.

Ventral surface.

Head: Light yellow tinged with red. Antennæ light yellow with last segment somewhat dusky at tip and with crimson areas on joints near and at junctures. Beak light yellow with dusky tip.

Thorax: Light yellow tinged with red. Legs of same color with last segment of tarsi somewhat dusky.

Abdomen: Darker than head and thorax, having dusky tinge, especially a band down either side extending from edge about half way to median line, containing along the edge yellow semicircular spots corresponding to those found on dorsal surface.

Sometimes the whole under surface is dusky and the coloration not as distinct as above indicated.

SECOND-STAGE NYMPH.

Shape and relative length of segments of antennæ and beak much as in first stage Sometimes almost entirely black after molting.

The following color notes refer to mature individuals:

[1] See Table I, giving lengths of antennal segments, p. 11.

Dorsal surface.

Head: Black.

Thorax: Black except for four yellow spots usually present, one near entire outer edge of prothorax and two, similarly located, on mesothorax.

Abdomen: Dark reddish. Tubercles black. Minute light spots sometimes present on median line. When present one is usually found between first and second and one between second and third tubercles. Four light areas, usually white, across base to form what approaches a band. Row of five light dots on either side of median line, the first and second very small and close together. Row of six light spots along either side of abdomen, the posterior one smallest and sometimes not apparent. All light spots are either white or light yellow, those over the central portion of the abdomen being usually yellow. Row of eight black semicircular spots along either edge of abdomen, one on a segment, their straight edges on line where dorsal and ventral surfaces of abdomen meet. Tip of abdomen black.

Ventral surface.

Head: Black. Antennæ and beak black, except for red areas between second and third and third and fourth antennal joints.

Thorax: Black except for yellow spots that may be present on prothorax and mesothorax, corresponding to those on dorsal surface, and reddish area between coxæ. Legs black.

Abdomen Reddish with row of five black spots extending from tip up median line and row of black spots along edge, corresponding to those on dorsal surface. Tip black.

About to molt they measure approximately 3 mm. in length and 2 mm. in width, being widest across the abdomen.

THIRD-STAGE NYMPH.

Shape, coloration, and general appearance same as in second instar, though black may sometimes be replaced by olive green.

When mature it measures about 3.6 mm. in length and 2.6 mm. in width across the abdomen.

FOURTH-STAGE NYMPH.

Shape as in preceding stages. The second segment of the antenna now longest. In this instar occur what may be termed light and dark forms as well as individuals of intermediate coloration. The light and dark forms are described below. When mature the nymph measures approximately 6.2 mm. in length and 4.7 mm. in width.

Light form, dorsal surface.

Head: Pale green with black border and black line on either side of tylus where it joins jugum. These lines extend to middle of base of head where they join small black area. Eyes black.

Thorax: Pale green with few scattered black dots and other black markings. Sides bordered with black and with orange-colored area near edge of prothorax and one of same color near edge of mesothorax.

Abdomen: Darker green than head and thorax. Darkest around glands, last two of which are salmon colored. Four white areas along base of abdomen nearly joined to form what approaches a band across base. Two small white dots on median line, one between first and second and one between second and third glands. Row of five white dots on either side of median line, diverging anteriorly and converging posteriorly. Row of six white dots, the posterior one much smaller than others, along either side of abdomen just inside connexivum. On connexivum six black-bordered, salmon-colored dots.

Ventral surface.

Head: Pale green with yellowish tinge anteriorly. Sides and front bordered with black. First joint of antenna for most part light green, others fuscous. Labrum fuscous, the rest of base of beak light green. Last two segments of beak fuscous.

Thorax: Pale green with few scattered black dots and lines. Sides bordered with black and with orange-colored area just inside border. Femora light green. Tibiæ and tarsi dusky to fuscous.

Abdomen: Pale yellowish green. Sides and posterior end bordered with black, with salmon-tinged band just inside border. Spiracles black.

Dark form, dorsal surface.

Head: Dark brown, nearly black, sometimes with jugum yellow.

Thorax: Dark brown, nearly black, except for yellow area near edge of prothorax and one near edge of mesothorax.

Abdomen: Dark brown, nearly black. Last two segments lighter than others White markings as in light form. Color of glands same as rest of ground color. Salmon-colored areas along connexivum absent.

Ventral surface.

Head: Greenish black. Beak and antennæ of same color.

Thorax: Greenish black except for yellowish areas near edge of prothorax and mesothorax and light, whitish band down median line under beak. Legs greenish black.

Abdomen: Light yellow tinged with red and with greenish-black border at sides and posterior end. Row of five greenish black spots along median line. Spiracles black.

FIFTH-STAGE NYMPH.

Shape much as in preceding stages, but development of wing pads now quite pronounced and basal portion of abdomen in part covered by them. Length, when mature, about 10 mm., width about 7 mm.

Light form, dorsal surface.

Head: Pale green with black border and a black area at base on either side of median line. Eyes for most part black.

Thorax and wing-pads: Pale green with black border on sides and with few scattered black dots and other black markings. A narrow orange-colored band just inside black border, more pronounced on prothorax.

Abdomen: Pale yellowish green with black area about rose-colored glands. Yellowish-white, rounded spots located as follows: Two small ones on median line, one between first and second and one between second and third glands; row of five on either side, just outside median line, the third and fourth largest; row of five on either side near connexivum, the first sometimes covered by wing-pads. On connexivum at either side of each segment, a rose-colored, black-bordered, somewhat semicircular area, its less curved border outward. Near posterior end of abdomen these areas not well defined.

Ventral surface.

Much as in light form of fourth-stage nymph except that band just inside black border of abdomen is rose colored.

Dark form, dorsal surface.

Head: Juga chrome orange with black border on outside edge. Rest of head and eyes dark brown, nearly black.

Thorax: For most part dark brown, nearly black. Black-bordered, orange-colored areas, one near both outside edges of prothorax and one near outside edge of both primary wing-pads. Yellowish area along inside edge of both primary wing-pads.

Abdomen: Dark brown, almost black.[1] At base a yellowish-white area on either side of median line. Other yellowish-white spots and rose-colored areas on connexivum as in light form.

Ventral surface.

Head: Olive green with black markings. Beak and antennæ olive green to black, lightest near base.

Thorax: Olive green with black markings except for chrome-orange areas near edge of prothorax and mesothorax. Legs olive green near base, becoming gradually darker to black tarsi.

Abdomen: Light yellow tinged with red and with black-bordered, rose-colored areas on connexivum corresponding to those on dorsal surface. Row of four greenish-black spots along median line. Spiracles black.

COMPARATIVE LENGTHS OF ANTENNAL SEGMENTS OF NYMPHS AND ADULT.

While the measurements given in the following table are taken from single individuals only, they indicate the comparative lengths of the segments in any one stage. It will be noted that the antenna of the nymph is made up of four segments while that of the adult is composed of five. In this connection it may be stated that the writer has seen an abnormal adult with one antenna composed of four segments and the other of five.

Up to and including the third instar the fourth segment of the antenna is longest. In the fourth and fifth instars the second segment is longest, while in the case of the adult the last three segments are of about equal length, any one being longer than either the first or the second segment.

TABLE I.—*Lengths of segments of antennæ of nymphs and adults of Nezara viridula.*

Stage.	First segment.	Second segment.	Third segment.	Fourth segment.	Fifth segment.
	Mm.	*Mm.*	*Mm.*	*Mm.*	*Mm.*
First-instar nymph	0.14	0.19	0.18	0.37	.....
Second-instar nymph	.15	.40	.33	.53	.....
Third-instar nymph	.18	.60	.50	.67	.....
Fourth-instar nymph	.29	1.17	.88	1.07	.....
Fifth-instar nymph	.44	1.71	1.22	1.27	.....
Adult	.53	1.07	1.66	1.76	1.56

DISTRIBUTION.

Bueno (9) states that *Nezara viridula* is recorded "from the whole of Europe except the extreme north, Asia, Africa, Malaysia, Australia, New Zealand, South America, at least in the north, Central America, and enters into the United States at the south, being found in Texas and Florida." Specimens have been seen from Cuba, Porto Rico, and St. Croix (U. S. Virgin Islands) in the Lesser Antilles.

[1] In individuals of this form examined by the writer the general color of the dorsal surface of the abdomen is much darker than Morrill's (7) figure would indicate.

In the United States (fig. 12) its range covers the extreme southern portion, although at times it occurs outside this area. In the files of the Bureau of Entomology there are records of its injurious occurrence in South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. This would indicate that the species is most numerous in the southern portion of the Cotton Belt.

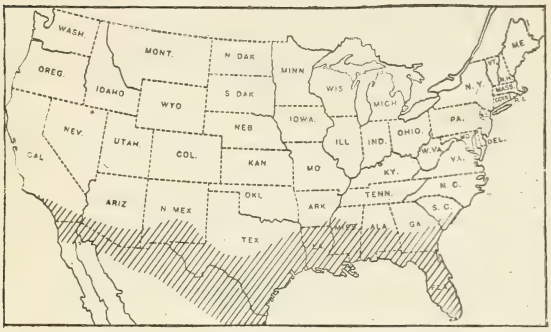

FIG. 12.—Map showing distribution of the Southern green plant-bug in the United States. Shaded areas indicates probable distribution.

From what has been observed in regard to the distribution of this species, it is evident that it is of foreign origin and, like many others of our principal pests, was introduced into this country many years ago. It is also obvious that it would be impossible even to hazard a conjecture as to the source from which it obtained a foothold in the southern United States.

REVIEW OF LITERATURE.

The species was first described as *Cimex viridulus* by Linnaeus (1) in 1758 from specimens from India and, according to Banks (6), it has been described since then under several other names by various authors. Van Duzee (5), Banks (6), and Barber (10) have mentioned areas and localities where it occurs and Van Duzee (5) and Parshley (11) have given characters by which it can be separated from closely related species.

Short notes regarding *Nezara viridula* were published in Insect Life in 1889 (2) and 1893 (3, 4). The notes published in 1893 relate to specimens sent to Washington by correspondents in Plaquemines Parish, La., and Altoona, Fla.

In 1910 Morrill (7) included a short account of the species in Bulletin 86 of the Bureau of Entomology. He mentioned the species as occurring on cotton, potato, and turnip, in Florida, Louisiana, and Texas, and gave figures of the light and dark types of nymphs in the fifth instar.

In 1912 Bueno (9) recorded the finding of the species in a greenhouse in Brooklyn, N. Y., and stated that he believed it to have been introduced from Europe or Florida, though he saw no reason why it could not establish itself in the latitude of Brooklyn inasmuch as it occurred in Germany and Russia. A short description was included and a number of food plants listed.

Froggatt (12), in 1916, recorded it as injuring tomato, French bean, and potato in New South Wales, and stated that it had appeared in the neighborhood of Sydney about five years previous to that date.

It was mentioned by Watson (14), in 1917, as an enemy of various crops in Florida, being treated especially as an enemy of truck and garden crops. Hand collecting was referred to as a satisfactory method of control to be practiced in the garden.

UNPUBLISHED RECORDS.

Among the records in the files of the Truck-Crop Insect Investigations, Bureau of Entomology, there are several notes referring to injury by the southern green plant-bug. Specimens were taken at the time the notes were made and these have been seen by the writer.

Mr. W. R. Beattie collected specimens at Mount Pleasant, S. C., on September 23, 1907, from tomato and stated that "in numerous instances" he "found as many as 5 to 20 working on a single fruit." On October 24 of the same year Mr. H. M. Russell reported severe injury to kumquats and Satsuma oranges in a grove of 1,000 trees at St. Leo, Fla., the insects apparently having migrated to the grove from neighboring cowpeas after these had died. The owner of the grove estimated that because of the injury he had lost all of his Satsuma fruit and 250 boxes of kumquats. The inside of the injured fruit was dry and pithy.

In a note from Brownsville, Tex., dated May 25, 1909, Messrs. D. K. McMillan and H. O. Marsh stated that these bugs were "very abundant during the fall and early winter on eggplant, tomato, okra, cabbage, and corn."

On October 20, 1917, Mr. M. H. Carter, of Troy, Ala., sent adults taken from cowpeas and wrote, "they have caused thousands of dollars damage in south Alabama this year by destroying the field-pea crop."

Mr. H. K. Laramore wrote on November 15, 1917, sending specimens collected at Jacksonville, Tex., on turnip and rutabaga, that the species was very common, doing "a great deal of damage to crucifers especially" and "I am told it is out of the question for them to attempt to raise late cowpeas in Cherokee County."

In the office records are included also other notes which, though unaccompanied by specimens, probably refer to this species. During November, 1911, the American Sumatra Tobacco Co., of Quincy, Fla., wrote regarding injury that "the loss attributable to them can be counted into thousands of dollars." In the case of tobacco it was stated that "wherever they sting a leaf it wilts the same and the leaf becomes absolutely worthless." Injury to velvet beans was also referred to.

Writing from Winnfield, La., on December 8, 1914, Mr. C. P. Seab stated that "it is this bug which attacks the lima and string bean as well as the cowpea. The farmers tell me it is almost impossible to have any kind of beans or peas on account of this bug."

February 2, 1917, Mr. John A. Creel wrote from Clapton, Ala., regarding "green bugs" that "attack peas of all varieties, velvet beans, peanuts, sugar cane, squash, okra, butter beans, etc.," and stated that "they attack any kind of grain or vegetable when in the green stage. The vegetable or grain will, after being punctured, become hard and dry, and good for nothing."

FOOD PLANTS.

Other writers have recorded *Nezara viridula* as feeding on beans, cotton, cowpea, *Gynandropsis pentaphylla*, hackberry, okra, maize, mulberry, orange, peas, pepper, potato, rice, sugar cane, sunflower, sweet potato, tomato, and turnip. We have taken it on a number of these plants and, in addition, on Brussels sprouts, cauliflower, collards, eggplant, globe artichoke, mustard, and radish.

While little damage is recorded to some of the plants mentioned and while it probably does not breed on all of them, it is a quite general feeder. Watson (14) states that it "attacks nearly all garden plants." Among vegetables the writer has found that serious injury is usually to tomato, bean, Irish potato, sweet potato, and okra. In the late fall and early winter the various stages are often abundant on mustard and turnip. They have also been observed congregated on the remaining green portions of okra plants after frost. It appears that legumes are favored as food plants. Farmers sometimes complain that the bugs greatly decrease the yield of seed of cowpeas by injuring the developing pods. Other writers mention the species as a pest on cotton and orange, and the records in the Bureau of Entomology, mentioned above, indicate that it feeds also on cabbage, corn, peanut, squash, tobacco, and velvet bean.

SEASONAL HISTORY AND HABITS.

HABITS OF THE ADULT.

The adults from the last generation of nymphs, some of which may be found feeding at Baton Rouge until late fall and early winter, often congregated on mustard and turnip, usually seek hibernating quarters. Rosenfeld (8) lists them among the insects taken from Spanish moss in Louisiana during December and January. Mr. O. W. Rosewall, professor of entomology at the Louisiana State University, has informed the writer that he has taken adults during the winter months under logs on batture land of the Mississippi River near Baton Rouge. A few, however, may be found in the field during

mild periods of weather throughout the winter. The overwintered adults mate in the spring and the writer has found eggs in the field at Baton Rouge as early as April 13. They have also been taken as late as November 8.

In feeding the adults prefer, as do the nymphs, the growing shoots or developing fruit of their host plants. They are active and capable of strong flight. Morrill (7) has recorded their capture at night and mentions the fact that when an electric light was turned on at night in a room where adults were confined they became restless. This was verified by observations at Baton Rouge.

When handled the adults give off a disagreeable odor. On this account they are sometimes spoken of as "stink-bugs."

COPULATION.

As has been noted by Whitmarsh (13) in the case of *Nezara hilaris*, the male and female of *viridula* usually remain in copulation for a considerable period of time, firmly attached to one another by the tips of their abdomens and with their heads facing in opposite directions. Copulation is also repeated at intervals, as the results of observations on reared individuals given in Table II will show.

OVIPOSITION.

The eggs are placed close together in clusters which, when viewed from above, have much the appearance of pieces of capped honeycomb (fig. 8). Individual eggs are attached to one another, and the cluster to the surface upon which it rests, by an adhesive substance given off by the female at the time of oviposition. In the field the female prefers the underside of a leaf as a location for the egg mass. Egg clusters deposited outside of confinement and examined by the writer have with one exception been made up of from 60 to 116 eggs. A cluster taken on November 3 contained only 36 eggs. Rearing records also indicate that the females sometimes deposit their eggs in smaller clusters, but in such instances this may have been due to their having been disturbed while ovipositing.

RECORDS OF REARED ADULTS IN CONFINEMENT.

Several adults, reared from nymphs, were kept under observation in the insectary until their death, especially with the idea of obtaining data on the period of time elapsing between the time the females emerged from the last nymphal skin and the time of egg laying, the number of eggs laid, copulation, and length of life of males and females. These individuals were confined in jelly glasses containing moist sand, a male and a female being placed in each tumbler. Green tomatoes were used as food and the contents of the tumblers examined daily. Table II includes notes made on some of the pairs.

Several females never laid eggs. One of these issued on July 22 and lived until October 30, part of the time in company with a male. No eggs were found in the ovaries at death. On the other hand, some females that laid eggs had well-formed eggs in the ovaries at death. Seventy-seven eggs were found in the ovaries of the female of Pair L after three clusters, containing 240 eggs in all, had been deposited.

While one female deposited a cluster of eggs 19 days after becoming adult, the average length of this period was nearly four weeks.

TABLE II.—*Length of life, dates of mating and egg laying, and number of eggs deposited by reared adults of Nezara viridula.*[1]

Pair.	Female issued.	Male issued.	Mated.	Male dead.	Female dead.	Eggs deposited.	Number of eggs.	Eggs deposited.	Number of eggs.	Eggs deposited.	Number of eggs.	Total number of eggs deposited.
A	July 13	July 14	July 31; Aug. 12, 15	Aug. 18	Aug. 21	Aug. 12	69	Aug. 20	62			131
B	July 16	July 20	Aug. 10, 11	Aug. 17	Aug. 22	Aug. 8	62	Aug. 14	76			138
C	July 11	July 21	Aug. 6, 9	Aug. 19	Aug. 24	Aug. 20	55					55
D	July 20	July 21	July 31; Aug. 1, 2, 3, 5, 13, 14, 16, 17	Aug. 27	Aug. 26	Aug. 13	52	Aug. 14	9			61
E	July 18	July 19	July 31; Aug. 2, 23, 24	Sept. 11	Sept. 3	Aug. 23	26	Aug. 27	4	Sept. 1	12	42
F	July 28	July 28		Aug. 6	Sept. 17	Aug. 20	59					59
G	Aug. 2	Aug. 2	Aug. 12, 28	Sept. 23	Sept. 1	Aug. 26	10	Aug. 27	65			75
H	July 25	July 25	Aug. 4, 6, 7, 13, 20	Aug. 22	Oct. 1	Aug. 13	70	Aug. 24	35			105
I	Aug. 14	Aug. 14	Sept. 1, 2	Sept. 30	Oct. 13	Sept. 18	78					78
J	Aug. 14	Aug. 14	Aug. 30; Sept. 9, 21, 24, 25	Nov. 2	Nov. 2	Sept. 9	79	Sept. 19	72	Sept. 30	69	220
K	Aug. 14	Aug. 14	Aug. 30; Sept. 6, 10, 18	Nov. 3	Sept. 20	Sept. 6	65	Sept. 10	23	Sept. 18	59	147
L	Aug. 13	Aug. 13	Aug. 27, 28, 30; Sept. 5, 7, 8, 9, 10, 11, 18	Sept. 24	Nov. 18	Sept. 5	87	Sept. 18	83	Oct. 18	70	240

[1] Temperatures to which individuals were exposed shown in figure 13.

PERIOD OF INCUBATION OF EGGS.

Table III gives data on eggs that were laid by females in the insectary, in which place the eggs were also kept until they hatched. Jars containing the adults and eggs were examined each morning and the date on which eggs were noted is taken to be the date on which they were deposited. In a like manner the date when nymphs were found is taken as the date of hatching.

The eggs composing any one cluster usually hatched at approximately the same time. An exception to this occurred in the case of a cluster of eggs deposited on October 16. Nymphs issued from some of these on October 29, when the thermograph reached a maximum of 87° F. at noon. At 2 p. m.[1] a "norther" caused a sudden drop in temperature, the thermograph registering 34° F. the next morning. No more nymphs were observed to issue on October 30 or 31 when the maximum temperatures were 53° and 63° F., respectively, but on November 1, when the maximum temperature was 70° F., other eggs hatched.

The temperatures to which the different egg clusters were exposed apparently governed to some extent the period of incubation, the period being longer for the lower temperatures.

TABLE III—*Incubation periods of egg clusters of Nezara viridula.*[1]

Deposited.	Hatched.	Days.	Deposited.	Hatched.	Days.	Deposited.	Hatched.	Days.
July 22	July 28	6	Aug. 18	Aug. 23	5	Sept. 4	Sept. 9	5
July 22	July 28	6	Aug. 20	Aug. 26	6	Sept. 5	Sept. 10	5
July 30	Aug. 4	5	Aug. 20	Aug. 26	6	Sept. 6	Sept. 12	6
Aug. 9	Aug. 14	5	Aug. 22	Aug. 28	6	Sept. 6	Sept. 12	6
Aug. 13	Aug. 18	5	Aug. 22	Aug. 28	6	Sept. 6	Sept. 11	5
Aug. 13	Aug. 18	5	Aug. 24	Aug. 30	6	Sept. 18	Sept. 25	7
Aug. 14	Aug. 19	5	Aug. 25	Aug. 31	6	Sept. 27	Oct. 6	9
Aug. 14	Aug. 19	5	Aug. 26	Aug. 31	5	Oct. 16	Oct. 29	13
Aug. 15	Aug. 20	5	Sept. 2	Sept. 7	5	Oct. 18	Nov. 9	22

[1] For temperatures to which eggs were exposed see figure 13.

HABITS OF THE NYMPHS.

The nymph issues from the egg through a circular opening at the top which it makes by removing the cap or lid. The brownish T-shaped egg-burster, by means of which the cap is removed, is usually left in the eggshell when the nymph emerges.

During the first instar the nymphs ordinarily cluster together, often on the eggshells, and apparently do no feeding. After the first molt they begin to search for food and soon become scattered. Subsequent to the first molt, and especially during the later instars, the nymphs are active and when disturbed they often seek protection by moving to places out of the disturber's range of vision. They are found usually upon those portions of the plant on which they prefer to feed—the growing shoots and more especially the developing fruit.

[1] All references to "clock time" refer to Standard Time.

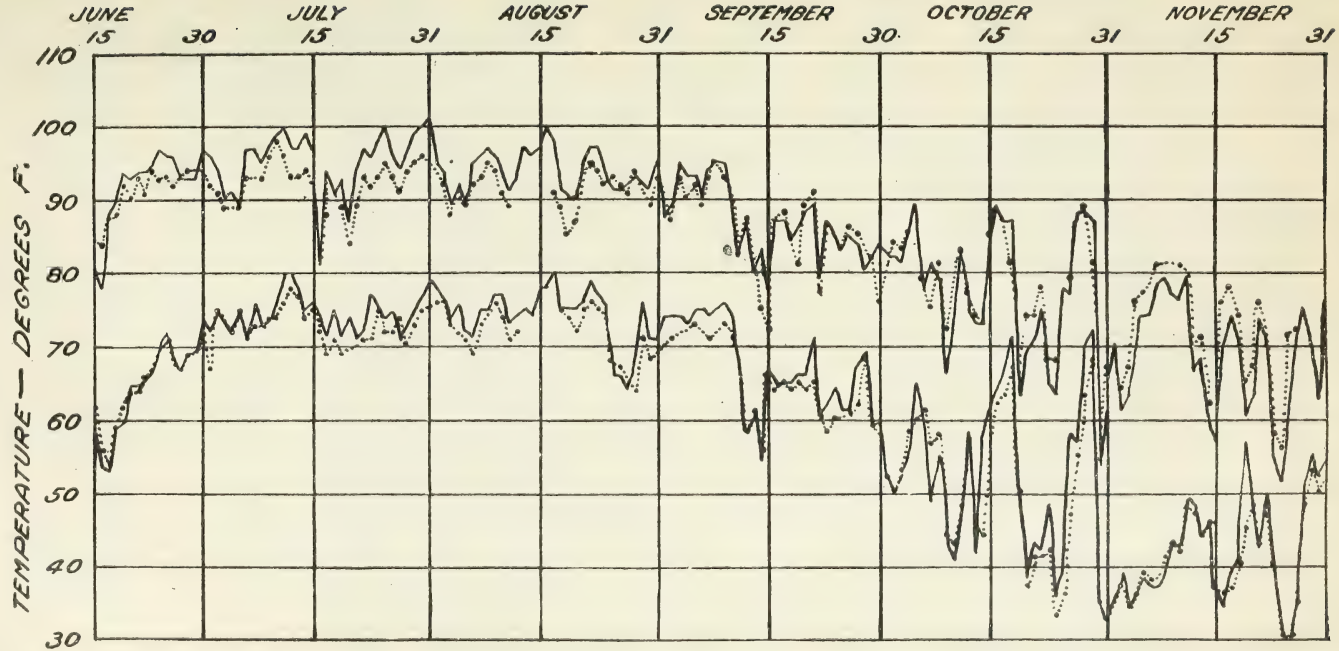

FIG. 13.—Showing temperatures at Baton Rouge, La., during the time when life-history studies of the Southern green plant-bug were conducted. Unbroken line indicates temperature in insectary where studies were conducted. Broken line indicates temperatures for Baton Rouge as given by the United States Weather Bureau.

When handled the nymphs give off a disagreeable odor. This odor is scarcely perceptible in the case of nymphs in the first instar but increases in strength in the succeeding stages.

PERIODS OF NYMPHAL STAGES.

Tables IV and V are introduced to show the minimum number of days spent by nymphs from different egg clusters in the five instars. Table IV refers to nymphs kept in the office and Table V to nymphs kept in the insectary. The nymphs issuing from a single egg cluster were kept together in a cloth-covered jar containing moist sand. Green tomatoes were used as food and proved very satisfactory. Fresh ones were placed in the jars at frequent intervals in order that the food supply might approximate that in the field.

The jars were examined daily, and the dates given for the different lots are those on which the first individual from a certain egg cluster issued from the egg or from a subsequent nymphal instar. It is assumed, therefore, that the first individual to issue from an egg cluster was the first to become adult.

Individuals from any one egg cluster spent about the same amount of time in either of the first two nymphal instars, but during the later instars the periods became less constant. Temperature conditions apparently had an important bearing over this. For instance, during a period of warm weather in the fall a few nymphs in a certain instar would molt; then the temperature would suddenly fall and several days of cool weather follow, no other nymphs molting until this period had elapsed. Periods of several days, therefore, sometimes occurred between the time when the first and last adults appeared. In the fall these periods were sometimes prolonged to 30 days.

The periods spent by the nymphs of different egg clusters in the succeeding instars were apparently influenced by the prevailing temperatures; low temperatures lengthening the periods. This can be seen by comparing the dates given in Table V with the insectary temperatures shown in figure 13.

TABLE IV.—*Minimum length of instars of Nezara viridula based on records of first individuals.*[1]

Lot.	Hatched.	Second instar.	Third instar.	Fourth instar.	Fifth instar.	Adult.
A	July 2	July 5	July 10	July 20	July 26	Aug. 2
B	July 4	July 7	July 13	July 19	July 29	Aug. 8
	Number of days to complete instar.					
A		3	5	10	6	7
B		3	6	6	10	10

[1] Average of maximum temperatures to which nymphs were exposed, 89° F.; average of minimum temperatures, 80° F.

TABLE V.—*Minimum length of instars of Nezara viridula based on records for first individuals.*[1]

Period spent in first instar.	Days.	Period spent in second instar.	Days.	Period spent in third instar.	Days.	Period spent in fourth instar.	Days.	Period spent in fifth instar.	Days.
June 18–22	4	June 22–26	4	June 26 to July 4.	8	July 4–12	8	July 22–31	9
Aug. 14–17	3	Aug. 22–29	7	July 7–13	6	July 12–22	10	Aug. 3–10	7
Aug. 18–22	4	Aug. 22–26	4	July 7–12	5	July 13–22	9	Aug. 5–12	7
Aug. 19–22	3	Aug. 22–28	6	July 24–30	6	July 26 to Aug. 3.	8	Sept. 7–20	13
Do	3	Aug. 23–29	6	Aug. 26 to Sept. 1.	6	July 30 to Aug. 5.	6	Sept. 11–26	15
Aug. 20–23	3	Aug. 27 to Sept. 2.	6	Aug. 28 to Sept. 4.	7	Sept. 1–7	6	Sept. 23 to Oct. 6.	13
Aug. 23–27	4	Aug. 31 to Sept. 7.	7	Sept. 8–16	8	Sept. 4–11	7	Sept. 24 to Oct. 17.	23
Aug. 28–31	3	Sept. 3–8	5	do	8	Sept. 16–22	6	Sept. 25 to Oct. 18.	23
Do	3	do	5	do	8	Sept. 16–23	7	Oct. 6–29	23
Aug. 30 to Sept 3.	4	Sept. 4–8	4	Sept. 19–27	8	Sept. 16–25	9	Oct. 6–28	22
Aug. 31 to Sept. 3.	3	Sept. 10–19	9	Sept. 20–28	8	Sept. 27 to Oct. 6.	9	Oct. 8–29	21
Aug. 31 to Sept. 4.	4	Sept. 13–20	7	do	8	Sept. 28 to Oct. 8.	10	Oct. 9–28	19
Sept. 7–10	3	Sept. 14–20	6	Sept. 25 to Oct. 5.	10	Sept. 28 to Oct. 9.	11		
Sept. 9–13	4	Sept. 17–25	8			Oct. 5–18	13		
Sept. 10–14	4	Oct. 17–29	12						
Sept. 12–17	5	Oct. 18 to Nov. 10.	23						
Oct. 6–15	9								
Oct. 11–17	6								
Oct. 14–18	4								

[1] For temperatures to which nymphs were exposed see figure 13.

NUMBER OF GENERATIONS ANNUALLY.

As has been stated, eggs have been taken in the field at Baton Rouge as early as April 13, and as late as November 8, while nymphs in the fifth instar were observed December 23. Life-history studies were conducted in an insectary where both the maximum and minimum temperatures are slightly higher than those given by the Weather Bureau of the United States Department of Agriculture for Baton Rouge (fig. 13). Under these conditions it would appear that, while the egg and nymphal stages may be passed in about a month, during the summer months, adults usually do not begin egg-laying until nearly four weeks after molting the last nymphal skin. Field and insectary observations indicate that four generations develop annually in the field at Baton Rouge.

NATURAL ENEMIES.

In spite of the disagreeable odor of the species of the genus, the Bureau of Biological Survey has recorded finding specimens of Nezara in the stomachs of certain birds, but it appears to have been always *hilaris* that was found. *N. viridula* is probably also eaten.

Morrill (7) and Whitmarsh (13) mention the fact that the eggs of *hilaris* are parasitized by a species of Trissolcus, and it would thus appear that the eggs of *viridula* would also be attacked by this para-

site, although many egg clusters of *viridula* collected in the field failed to show any evidence of parasitism.

A PARASITE.

Trichopoda pennipes Fab.—Morrill (7) mentions the presence of the egg of a tachinid fly on a nymph in the fifth instar collected at Quincy, Fla., among a lot of 39 specimens in stages susceptible to parasitism by tachinids. The writer has found tachinid eggs common on adults taken at Baton Rouge, and in all cases where the flies have been reared they have proved to be adults of *Trichopoda pennipes* (fig. 14), which is known to attack a number of the larger Hemiptera. Upon completing their growth the larvæ left the bodies of their hosts and transformed to puparia in the soil. The puparium is cylindrical in shape with rounded ends. It measures about 7 mm. in length and 3.5 mm. in width and when fully colored is dull reddish black.

FIG. 14.—*Trichopoda pennipes*, a tachinid fly parasitic on the Southern green plant-bug: Adult. Enlarged about 3 diameters. (Chittenden.)

Of 73 adults collected on mustard December 6, 1915, 13 males and 5 females, or nearly 25 per cent, bore tachinid eggs. Most of the adults had only one egg upon them, but one had two, two three, and one four. Of the 26 eggs on all adults, 4 were on the dorsal surface and 20 on the ventral surface, while 2 were on the eyes. Four eggs were found on the head, 10 on the prothorax, 3 on the mesothorax, 2 on the metathorax, 5 on the abdomen, and 2 on the wing covers. An egg has also been observed on the femora of one of the fore legs.

The surface of the egg that is quite firmly attached to the host is usually flat. The opposite surface is strongly convex and is ellipsoidal in outline. The entire surface of the egg is glistening and is marked by minute hexagonal reticulations. The egg measures about 0.54 mm. in length and 0.35 mm. in width. Its color varies from white to gray, apparently being white when first deposited.

PREDACIOUS ENEMIES.

Podisus maculiventris Say.—A single instance of this common pentatomid bug preying upon *Nezara viridula* was noted in the field at Baton Rouge during December, 1914. This individual had a nymph in the fifth instar impaled on its beak.

Euthyrhynchus floridanus L.—Among the notes in the Bureau of Entomology files made by the late H. M. Russell, mention is made of two predacious enemies observed by him in Florida during 1907.

Specimens of *Nezara viridula* accompanied the notes. At Dade City, on November 11, an adult of the pentatomid bug *Euthyrhynchus floridanus* was found with its rostrum thrust into a mature individual.

Bicytes quadrifasciata Say.—Mr. S. A. Rohwer of the Bureau of Entomology states that a bembecid wasp which Mr. Russell collected at St. Leo, Fla., October 22, 1907, belongs to this species. The specimen was taken while in flight with an adult of *Nezara viridula* grasped in its mandibles.

CLIMATE AS A CONTROL FACTOR.

Whitmarsh (13) considers climate an important factor in the natural control of the related *Nezara hilaris* in Ohio. Cold winters, or periods of cold weather following unusually warm weather during the winter months, killed many individuals of that insect. Observations made in connection with *Nezara viridula* in the Gulf States indicate that sudden drops in temperature during the winter months kill many individuals in the field. In Florida Mr. H. M. Russell found, on December 5, 1907, "a few dead adults after the freeze" of the preceding night. Writing from Brownsville, Tex., on May 25, 1909, Messrs. D. K. McMillan and H. O. Marsh stated that the "species has been conspicuously absent for several months, though very abundant during the fall and early winter * * *" and added "It may be that the two freezes of January 15 and early February may have had some influence."

The writer has found that in the insectary at Baton Rouge individuals, especially in the nymphal stages, are sometimes killed by low temperatures during the winter months.

METHODS OF ARTIFICIAL CONTROL.

It is well known that the pentatomid bugs and other large plant-bugs are quite resistant to contact insecticides, and the experiments indicate that it is difficult to control the southern green plant-bug by using insecticides of this type.

SPRAYING WITH NICOTINE SULPHATE.

Individuals in various nymphal instars, as well as adults, have been drenched with dilutions of nicotine sulphate which contained 40 per cent of nicotine by weight in combination with yellow laundry soap at the rate of 2 pounds to 50 gallons of water. These individuals were then kept under observation in the insectary and the effects of the different mixtures upon them noted. A dilution of 1 part nicotine sulphate to 300 parts of water killed all nymphs, but even in the proportion of 1 to 100 the nicotine had little effect on the adults. A dilution of 1 to 600 was not effective against nymphs in the third, fourth, and fifth instars. On the

day following the treatment over 50 per cent were active, and even in the case of nymphs in the third instar at least 50 per cent survived.

SPRAYING WITH KEROSENE EMULSION.

Experiments with strong mixtures of kerosene-soap emulsion also gave unsatisfactory results. One part of stock solution, made up of kerosene and yellow laundry soap, to two parts of water did not kill all nymphs that were drenched with it. Undiluted kerosene, as would be expected, quickly killed individuals in both the nymphal and adult stages.

In the experiments it was noted that nymphs which, immediately after being drenched with a contact insecticide, apparently showed signs of approaching death, recovered later.

HAND PICKING.

Hand picking can be done profitably where valuable vegetable crops are being attacked. The bugs may be collected in a receptacle containing a little water coated with a film of kerosene, or some other collecting device may be used. Where the bugs occur on other than low-growing plants the receptacle may be a pan or wide-mouthed dish and the bugs may be brushed or knocked from the plants into it. Collecting can be done best in the early morning, or during cool weather, when the bugs are sluggish. In addition to collecting and destroying the adults and nymphs, the destruction of egg clusters is recommended.

In order to secure a maximum reduction in the amount of damage done to the plants, hand picking not only should be carefully done, but should be put into practice when the attack begins.

USE OF TRAP CROPS.

The adults are attracted to mustard and turnips during the fall, as indicated by the collections referred to below. These were made from a few plants in a garden at Baton Rouge where serious injury by the species is seldom noted. About 15 minutes a day were spent in the work, all collections being made from the same plants. It would appear that after the first collection the succeeding adults were individuals that came to the plants from the time of one collection to the next, it being unlikely that many adults escaped at the time each collection was made.

On October 24, 47 adults were collected; on October 25, 81; on October 28, 79; and on October 31, 42. In addition to the foregoing 249 adults, 148 nymphs were collected.

The fact that nymphs and adults are often very abundant in the late fall on turnip and mustard suggests that a few of these plants, or others on which the southern green plant-bug is found to congregate, might be grown as trap crops in sections where serious injury occurs. The bugs might be hand picked or killed by spraying with a

strong contact insectide or by using a gasoline torch. Even if it were found necessary, in order to kill the nymphs and adults economically, to use measures that would injure the plants, the operation might prove profitable in areas where serious damage occurs. Where the plants have not been grown especially as trap crops the destruction of the nymphs and adults when they congregate in large numbers would assist materially in reducing their destructiveness.

SUMMARY OF CONTROL MEASURES.

It would seem that spraying with a contact insecticide is not practical, unless employed in connection with trap crops where injury to the plants by the insecticide is not of importance. While it is possible to use mixtures strong enough to kill even the adults, the injurious effects of the insecticide upon the plants, as well as their present cost, would have to be considered.

The writer is inclined to agree with Watson (14) that hand picking is the most satisfactory control measure where valuable vegetable crops are seriously attacked, but for less valuable crops it is questionable whether this could be profitably done.

The fact that the adults congregate on turnip and mustard late in the fall in Louisiana suggests that a few of these, or other plants upon which they congregate, might be grown to serve as a trap crop.

GENERAL SUMMARY.

A pentatomid bug, *Nezara viridula* L., here given the common name of the southern green plant-bug, causes severe injury to cultivated crops in the southern portion of the Cotton Belt of the United States. Among the vegetable and truck crops injured are tomato, beans, Irish potato, sweet potato, okra, mustard, and turnip.

The species is widely distributed over the world and attacks a great variety of plants.

The adults and nymphs cause injury by inserting their beaks into the plant tissue and extracting the juices. Young growing shoots and developing fruit are most seriously injured.

Life-history studies have been carried on at Baton Rouge, La., in an insectary where the average maximum and minimum temperatures are slightly higher than those given by the United States Weather Bureau for the same locality. One female began egg-laying 19 days after becoming adult, although the average length of this period for the several females under observation was about four weeks. The number of eggs deposited by different females varied greatly. Some laid no eggs, while one deposited 240 and had 77 well-developed eggs in the ovaries at death. The eggs are placed in clusters, and in the field they have been found always on the underside of leaves. These clusters were made up of from 36 to 116 eggs.

In the insectary the minimum period necessary for the incubation of the eggs was 5 days. For the five nymphal stages the minimum periods were 3, 4, 5, 6, and 7 days, respectively, a total of 30 days for the egg and nymphal stages. The temperatures to which the eggs and nymphs were exposed apparently had a bearing on the length of the period of any stage. Development was more rapid during the summer than during the fall.

Eggs have been found in the field at Baton Rouge as early as April 13 and as late as November 8. It is probable that in this latitude four generations may develop in a year. Adults are found hibernating during the winter months, but they also occur on plants in the field during mild periods of weather during this season.

Four enemies have been observed, the tachinid fly *Trichopoda pennipes* Fab. apparently being the most important.

As a method of control the collection and destruction of eggs, nymphs, and adults is recommended where valuable vegetable crops are attacked. Adults congregate on turnip and mustard during the fall and a few of these plants, or others on which they congregate, might be grown as trap crops in sections where serious injury by the species occurs. The adults may be collected from these plants and destroyed.

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Page 444: Short original description of species as *Cimex viridulus*, in Latin. "*Habitat in* Indiis."

(2) [Riley, Charles V., and Howard, Leland O.]
1889. Special notes. *In* U. S. Dept. Agr. Div. Ent. Insect Life, v. 2, no. 3, p. 61.
Review of "Notes on Indian insect pests," which forms Number 1 of Volume I of "Indian Museum Notes." First part by E. T. Atkinson makes mention of occurrence on potato halms.

(3) [Riley, Charles V., and Howard, Leland O.]
1893. Extracts from correspondence. The sweet-potato root-weevil. *In* U. S. Dept. Agr. Div. Ent. Insect Life, v. 5, no. 4, p. 261.
Sent to Washington with larvæ of *Cylas formicarius* with letter from correspondent in Plaquemines Parish, La., dated December 22, 1892.

(4) [Riley, Charles V., and Howard, Leland O.]
1893. Extracts from correspondence. Plant-bugs injuring oranges in Florida. *In* U. S. Dept. Agr. Div. Ent. Insect Life, v. 5, no. 4, p. 264, 265.
Sent in by correspondent from Altoona, Fla., with letter dated December 7, 1892. Puncturing rind of nearly ripe or ripe oranges on tree.

(5) Van Duzee, Edward P.
1904. Annotated list of the Pentatomidae recorded from America north of Mexico, with descriptions of some new species. *In* Trans. Amer. Ent. Soc., v. 30, p. 1–80.
Given in table of species of Nezara (p. 57, 58). Statement that Dr. Uhler said that species inhabited littoral plains of United States from Virginia to Florida and Louisiana.

(6) Banks, Nathan.
1910. Catalogue of the Nearctic Hemiptera-Heteroptera. American Entomological Society, Philadelphia. 103+viii p.
Page 88: Synonymy. Distribution given as Southern States.

(7) Morrill, A. W.
1910. Plant-bugs Injurious to Cotton Bolls. U. S. Dept. Agr. Bur. Ent. Bul. 86. 110 p., 25 fig., 5 pl.

Pages 82–83: Observations concerning occurrence on cotton, potato, and turnip in Florida, Louisiana, and Texas. Mention of tachinid egg on nymph in Florida. Original figures of light and dark types of nymphs in fifth instar (fig. 16).

(8) Rosenfeld, J. H.
1911. Insects and spiders in Spanish moss. *In* Jour. Econ. Ent., v. 4, no. 4, p. 398–409.

(9) Bueno, J. R. de la Torre.
1912. Nezara viridula Linné, an hemipteron new to the northeastern United States. *In* Ent. News, v. 23, no. 7, p. 316–318.

In greenhouse in Brooklyn, N. Y., December 10, 1911. Author believes it brought from Europe or Florida; sees no reason why it could not establish itself about Brooklyn, because of occurrence in Germany and Russia. Distribution, food plants, short description, and mention of character by which species may be separated from *hilaris* and *pennsylvanica*.

(10) Barber, H. G.
1914. Insects of Florida. II. Hemiptera. *In* Bul. Amer. Mus. Nat. Hist., v. 33, art. 31, p. 495–535.

Page 523: Gives localities where species has been taken in Florida.

(11) Parshley, H. M.
1915. Systematic papers on New England Hemiptera. II. Synopsis of the Pentatomidae. *In* Psyche, v. 22, no. 5, p. 170–177, pl. 16.

Page 175: Given in synopsis, though not known to occur in New England.

(12) Froggatt, W. W.
1916. The tomato and bean bug (Nezara viridula Linn.). *In* Agr. Gaz. N. S. Wales, v. 27, pt. 9, p. 649–650, 1 pl.

First appeared on tomato plants in the neighborhood of Sydney some five years previously. Increased in numbers during last two years and has become a pest of the fruits and foliage of tomato, the foliage and young pods of French beans, and potato plants. Short account of distribution, injury, and stages. Suggests hand picking and use of "oil spray or tobacco and soap wash" against nymphs, as methods of control. Original figures of egg, first, second, and fifth instar nymphs, and adult.

(13) Whitmarsh, R. D.
1917. The green soldier bug, Nezara hilaris Say. Ohio Agr. Exp. Sta. Bul. 310, p. 517–552, 15 figs. [+1].

An extended, well-illustrated account concerning the related *Nezara hilaris* Say, based principally on observations in Ohio. Information regarding food plants, life history, habits, parasite, and climate as a control measure. Description of stages and an account of character and extent of injury to peaches, as a pest of which it is considered. In introduction (p. 519) statement that this "or more probably a closely related species, *Nezara viridula*," has been reported as an enemy of peaches in Florida.

(14) Watson, J. R.
1917. Florida truck and garden insects. Univ. of Fla. Agr. Exp. Sta. Bul. 134, p. 34–127, fig. 10–66.

Pages 83–84: General account under name of "pumpkin bug." Attacks nearly all garden plants, especially legumes and particularly cowpea. Several generations a year, adults hibernating in fall and coming out early in spring. Control difficult. Young may be killed by kerosene emulsion or strong soap solutions but adults only at strengths that would injure plants. Hand collecting, in morning or on cold, rainy day, practical in garden or in particularly valuable patch of cowpeas. In ordinary field of cowpeas planting plenty of seed and keeping plants growing vigorously recommended. Mentioned elsewhere in bulletin as injurious to beans, okra, peas, pepper, Irish potato, sunflower, and tomato.

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